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Circuits and the Flow of Electricity Lesson Plan

Michigan Grade Level Content Expectations and Common Core State Standards

6th Grade:

- **ELA:**
  - SL.6.4 Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
  - SL.6.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.
  - L.6.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
  - WHST.6.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

7th Grade:

- **ELA:**
  - SL.7.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
  - SL.7.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.
  - L.7.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
  - WHST.7.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

8th Grade:

- **ELA:**
  - SL.8.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.
  - L.8.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
  - RST 6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
  - WHST.8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

High School

- **ELA:**
  - SL.9-10.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.
  - L.9-10.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

- RST 9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
- SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.
- RST 11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
- L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

- Science:
  - P4.10C Given diagrams of many different possible connections of electric circuit elements identify complete circuits, open circuits, and short circuits and explain the reasons for the classification.
  - P4.10D Discriminate between voltage, resistance, and current as they apply to an electric circuit.

Lesson Outcome

The student will apply understanding of current electricity to design a circuit and describe its workings.

Rationale / Purpose for Lesson

To understand current electricity, many vocabulary words must be introduced. The first part of this lesson uses a hands-on, problem-solving activity that helps students define the vocabulary terms and demonstrate the terms' relationships. After gaining foundational understanding, students create their own circuits.

Resources / Materials Required

- 12 small balls (such as tennis balls or other soft balls)
- Copies of "Making Circuits" handout (below)
- 1 Circuit Kit for each group. Circuit Kits contain 1-D Cell battery, Battery holder, 2 - 1.5 volt bulbs, 2 sockets for the light bulbs (or E-10 light bulb bases), and 4 pieces of 6-inch insulated solid strand copper wire (18–22 gauge), with one inch of insulation removed at each end wire. Materials for Circuit Kits can be purchased at a local hardware store.
- Paper to record observations
- Pen or pencil to record observations

Introduction

- Ask two student volunteers to go to the front of the classroom. Assign one student the role of "the battery" and the other student the role of "the light bulb." It may be helpful to have each student stand by the chalkboard with a picture of his or her role (the battery or light bulb) nearby.
- Ask the students, "How can the battery give energy to the light bulb in order to create light?" Provide "the battery" with a basket of balls. Explain that the balls represent the **electrons** of an atom. Draw a diagram of an atom and discuss the negative charge of electrons. Explain that the electrons can carry energy and it is the flow of electrons that can generate electricity.
- Have "the battery" toss the balls to the light bulb. Now the light bulb has been supplied energy to generate light.

Procedures

- Once "the battery" has thrown all of the balls to "the light bulb" the supply of energy to the light bulb is exhausted and no more light can be generated. Ask the students, "How can the light bulb be lit for a longer period of time?" Possible answers:
    - Have more balls
    - Have the light bulb return the balls to the battery quickly

    While the first answer would still work for only a limited time, the second answer introduces the term **circuit**. A circuit is a complete path; in this case the path is completed when the balls are returned to their starting point and can then be given more energy and used again.

- Ask the students, "How could the light bulb give off light that is brighter?" Possible answers:
    - Have each ball carry more energy by making the balls bigger. (In this case, using basketballs for example.) However, in an atom, it is easier to move the small, negatively charged electrons than the larger, positive charges.
    - Throw the ball harder. This introduces the term **voltage (V)**. Voltage is the measure of pressure under which electricity flows; in this case it is the measure of how much energy or force "the battery" is giving each ball. If the same number of balls are thrown, but each ball is given more force or energy, more power will be sent to the light bulb.
    - Throw the balls faster; send more balls to the light bulb per second. This introduces the terms **current (I)** - the movement or flow of electricity, and **amps** - the measure of the amount of electrical current. Since the electrical current is how many electrons pass by each second, if we send twice as many electrons or balls each second, we will send twice the energy.

  - Throw the balls harder *and* faster. This introduces the equation of **total power (P)**, which is the product of current and voltage. P = I x V. In this case, the total power would be number of balls thrown multiplied by how much energy each one has.
- Distribute the "Making Circuits" handouts and provide each group of three or four students with a Circuit Kit. Allow students time to complete the activities on the handout.

Closure

- Have students show their completed working circuits to the class.
- Ask students to explain the circuits by tracing the flow of energy from the battery through the course of the circuit. Have them either present this explanation or write it.

Extensions

- Pose the following question to students: "Will the light bulbs in the parallel circuit or the series circuit burn brighter?"
- Have students test their predictions. Ask students if their predictions were correct and to explain the results of the test.
- After a simple circuit is constructed, investigate electric insulators and conductors by completing the Conductors and Insulators lesson plan on our website.

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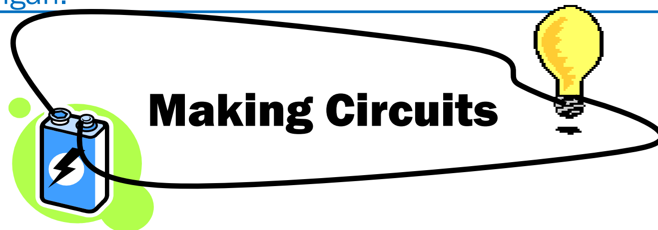


Making Circuits

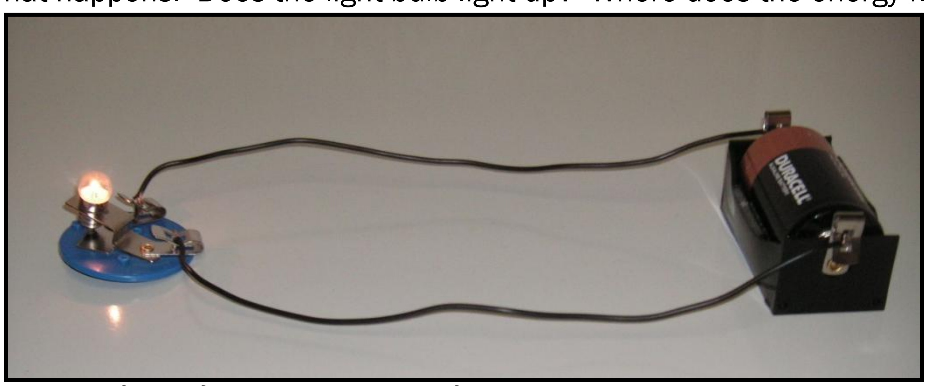
Materials in the "Circuit Kit"

- 1-D Cell battery
- Battery holder
- 2 – 1.5 volt bulbs
- 2 sockets for the light bulbs (or E-10 light bulb bases)
- 4 pieces of 6-inch insulated solid strand copper wire (18–22 gauge), with one inch of insulation removed at each end wire
- Student collection data sheet (one per student)

Directions: record your findings on the student collection data sheet

A. Simple circuit with single light bulb:

1. Using two wires, connect one end of each wire to the light bulb base.
2. Connect the other end of each wire to the battery, unless this has already been done for you.
3. Record what happens. Does the light bulb light up? Where does the energy flow? Describe



and illustrate the flow of electrical current from the battery through the wires and to the bulb.
4. Using your circuit, demonstrate how switches must work to turn lights on and off. Draw a diagram of what the circuit would look like if the switch was in the "off" position.

B. Parallel circuits:

Parallel circuits are circuits in which electrical current from the battery flows with equal voltage into two or more bulbs. In this type of circuit, electricity can flow through more than one path.

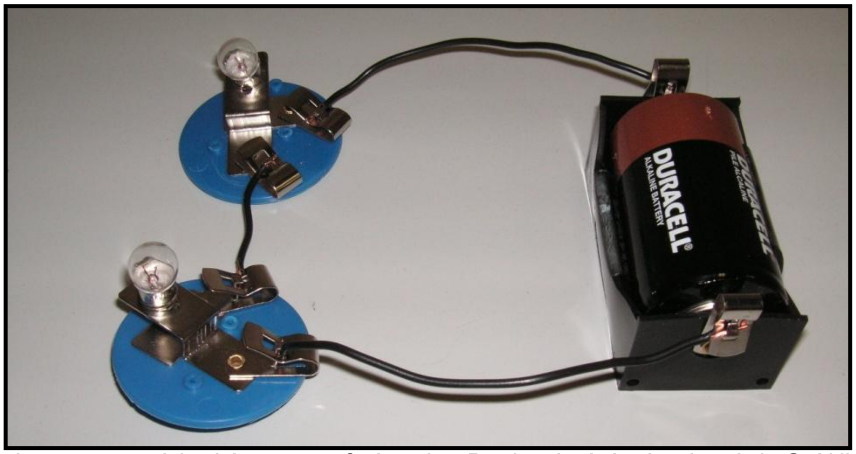
1. To make a parallel circuit, you will need two more pieces of wire, an additional light bulb and socket. Connect one end of the two new wires to the new light bulb. Connect the other ends of the two new wires to the first light bulb (that is still attached to the battery.

2. Record what happens with this type of circuit. Do both light bulbs light? What happens if one light bulb is unscrewed from its socket? Why?

C. Series circuits:

Series circuits are circuits in which electrical current from the battery flows through one bulb and then through another bulb. Electricity in this type of circuit can only flow in one path.

1. Rearrange the position of the wires and light bulbs in your circuit to create a series circuit. You will need three pieces of wire (only one if the battery holder already has one attached to each side. Connect one end of the wire the battery is attached to at the end of the first light bulb. Connect one end of the second piece of wire to the first light bulb and the other end of the wire to the second light bulb. Connect the other end of the piece of wire attached to the battery to the second light bulb.



2. Record what happens with this type of circuit. Do both light bulbs light? What happens if one light bulb is unscrewed from its socket? Why?

Student Data Collection Sheet

A. Simple circuit with single light bulb:

Does the light bulb light?

Where does the energy flow?

Describe and illustrate the flow of electrical current from the battery through the wires and to the bulb.

Using your circuit, demonstrate how switches must work to turn lights on and off. Draw a diagram of what the circuit would look like if the switch was in the "off" position.

B. Parallel circuits:

Record what happens with this type of circuit.

Do both light bulbs light?

What happens if one light bulb is unscrewed from its socket? Why?

C. Series circuits:

Record what happens with this type of circuit.

Do both light bulbs light?

What happens if one light bulb is unscrewed from its socket? Why?